9. An electrical network comprising:

a radio frequency (RF) generator for generating an RF signal, the RF generator having a source impedance;

a load receiving the RF signal, the RF signal providing a driving energy to the load, the load having a variable load impedance;

a matching network interposed between the RF generator and the load, the matching network having a network impedance which may be varied, the matching network detecting at least one of a phase and magnitude error and generating at least one of a corresponding phase error signal and a magnitude error signal, the matching network varying at least one of the phase and the magnitude in order to vary the network impedance; and

a controller receiving the at least one phase error signal and magnitude error signal, the controller applying fuzzy logic to the at least one of the phase error signal and the magnitude error signal in order to generate at least one control signal to vary the network impedance, thereby matching the source impedance and the load impedance.

10. The network of claim 9 wherein the controller further comprises a fuzzy inference module receiving the at least one phase and magnitude error signals and defining a membership value that varies in accordance with membership in at least one of a fuzzy set.

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11. The network of claim 10 wherein the controller further comprises a rules module having a set of rules applied in accordance with the membership values, the rules module generating at least one fuzzy output.

12. The network of claim 11 wherein the controller further comprises a defuzzification module, the defuzzification module converting the at least one fuzzy output to the at least one control signal.

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13. The network of claim 9 wherein the matching network further comprises at least one of a variable capacitance and a variable inductance.

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14. The network of claim 9 wherein the matching network further comprises a circuit for varying the network impedance.

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15. The network of claim 9 wherein the load is a RF plasma chamber.

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16. An electrical network comprising:

a radio frequency (RF) generator for generating an RF signal, the RF generator having a source impedance,

a load receiving the RF signal, the RF signal providing a driving energy to the load, the load having a variable load impedance;

a matching network interposed between the RF generator and the load, the matching network having a network impedance which may be varied, the matching network detecting at least one network parameter and generating at least one sensed signal, the matching network varying the network impedance in order to match the load impedance and the source impedance; and

a controller receiving the at least one sensed signal, the controller applying fuzzy logic to the at least one sensed signal in order to generate at least one control signal to vary the network impedance, thereby matching the source impedance and the load impedance.

17. The network of claim 16 wherein the controller further comprises a fuzzy inference module receiving the at least one sensed signal and defining a membership value that varies in accordance with membership in at least one of a fuzzy set.

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18. The network of claim 17 wherein the controller further comprises a rules module having a set of rules applied in accordance with the membership values, the rules module generating at least one fuzzy output.

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19. The network of claim 18 wherein the controller further comprises a defuzzification module, the defuzzification module converting the at least one fuzzy output to the at least one control signal.

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20. The network of claim ~~16~~ wherein the matching network includes at least one of a variable capacitance and a variable inductance.

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21. The network of claim ~~16~~ wherein the matching network further comprises a circuit for varying the network inductance.

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22. The network of claim ~~16~~ wherein the matching network further comprise a circuit for varying the network impedance.

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23. The network of claim 9 wherein the load is a RF plasma chamber.

24. A method of tuning an RF impedance matching network having an input which receives RF power and an output which applies the power to a RF load, the matching network having a variable impedance, comprising the steps of:

determining a phase error and a magnitude error and generating a corresponding phase error signal and a corresponding magnitude error signal; and

applying fuzzy logic to the phase and magnitude error signals to generate fuzzy output signals based upon the phase and the magnitude error signals and generating a control signal to adjust the variable impedance of the matching network.

25. The method of claim 24 wherein the step of applying fuzzy logic further comprises applying the phase and magnitude error signals to a fuzzy logic inference function, the phase and magnitude error signals each having at least one respective membership value in at least one fuzzy set.

26. The method of claim 25 wherein the step of applying fuzzy logic further comprises applying logic rules to the at least one respective membership value to generate at least one respective fuzzy output value.

27. The method of claim 26 wherein the step of applying logic rules further comprises the step of weighting the at least one respective fuzzy output value according to the at least one respective membership value.

28. The method of claim 27 wherein the step of applying fuzzy logic rules further comprises the step of combining said weighted at least one respective fuzzy output value to produce the control signal.

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29. The method of claim 26, wherein the fuzzy logic rules comprise a matrix of NxM fuzzy output values, where N is the number of fuzzy sets of a first sensed signal and M is the number of fuzzy sets of a second sensed signal, and each fuzzy output value corresponds to a predetermined set of the first sensed signal and a predetermined set of the second sensed signal.

30. The method of claim 25 wherein the at least one fuzzy set comprises a plurality of fuzzy sets centered respectively about zero, a medium positive value, a medium negative value, a high positive value, and a high negative value.

31. A method of tuning an RF impedance matching network having an input which receives RF power and an output which applies the power to a RF load, the matching network having a variable impedance, comprising the steps of:

determining a network parameter and generating a corresponding sensed signal that varies in accordance with the network parameter; and

applying fuzzy logic to the sensed signal to generate fuzzy output signals based upon the sensed signal and generating a control signal to adjust the variable impedance of the matching network.

32. The method of claim 31 wherein the step of applying fuzzy logic further comprises applying the sensed signal for a fuzzy logic inference function, the sensed signal having at least one respective membership value in at least one fuzzy set.

33. The method of claim 32 wherein the step of applying fuzzy logic further comprises applying logic rules to the at least one respective membership value to generate at least one respective fuzzy output value.

34. The method of claim 33 wherein the step of applying logic rules further comprises the step of weighting the at least one respective fuzzy output value according to the at least one respective membership value.

35. The method of claim 34 wherein the step of applying fuzzy logic rules further comprises the step of combining said weighted at least one respective fuzzy output value to produce the control signal.

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36. The method of claim 33, wherein the fuzzy logic rules comprise a matrix of NxM fuzzy output values, where N is the number of fuzzy sets of the sensed signal and M is the number of fuzzy sets of a second sensed signal, and each fuzzy output value corresponds to a predetermined set of the first sensed signal and a predetermined set of the second sensed signal.

37. The method of claim 32 wherein the at least one fuzzy set comprises a plurality of fuzzy sets centered respectively about zero, a medium positive value, a medium negative value, a high positive value, and a high negative value.